Insect Pests in Corn

Katelyn A. Kesheimer, Ph.D.
Assistant Professor and Extension Entomologist
Alabama Cooperative Extension System
Insect pests of corn

• Pests from crop emergence to post-harvest
• A good integrated pest management plan begins before you plant
• Varietal selection
  • Genetics specifically adapted to your area
  • What type of insect control is needed
  • Follow refuge requirements!
• Risk reduction
  • Crop rotation
  • Tillage
  • Seed treatments
  • Timely harvest
Stink bugs in corn

- Brown stink bug
  - *Euschistus servus*
- Brown marmorated stink bug
  - *Halyomorpha halys*
- Southern green stink bug
  - *Nezara viridula*
- Green stink bug
  - *Chinavia halaris* (Say)

- Overwinter as adults in protected areas
- Early hosts include winter weeds & wheat
- Mild winters encourage survival
Stink bugs

Brown stink bug

Brown marmorated stink bug

Green & Southern green stink bugs
Stink bugs

Brown stink bug

Brown marmorated stink bug

Green & Southern green stink bugs
Scouting for stink bugs

• Scout early and often
  • V1 to R2
• They’re sneaky! Will hide or drop off plant as you’re scouting
• Look at plants 1-2 rows over
• Check several areas of the field
• Typically worse at the edge of the field
Stink bug damage
Stink bug damage

- Vegetative – stunting, plant may develop multiple stems
- Pre-tassel – damaged ears crook away from plant stem; aborted kernels
- Reproductive – smaller kernels, potential for infection

<table>
<thead>
<tr>
<th>Stage</th>
<th>Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1 – V6</td>
<td>1 stink bug / 10 plants</td>
</tr>
<tr>
<td>V14 – VT</td>
<td>1 stink bug / 8 plants</td>
</tr>
<tr>
<td>R1 – R2</td>
<td>1 stink bug / 4 plants</td>
</tr>
</tbody>
</table>
Treating for stink bugs

• Successful control:
  1. Coverage
  2. Timing

• Pyrethroids
  • Ex. Warrior II, Declare, Mustang Maxx, Brigade, Delta Gold, etc.

• Brown stink bugs are harder to kill
  • If these make up the majority of what you are finding, go with the highest rate of Bifenthrin (ex. Hero, Brigade 2EC)
Caterpillar pests of corn

• Prior to whorl stage:
  • Armyworms
    • Especially after a cool, wet spring

• In whorl stage:
  • Fall armyworm
  • Corn earworm
  • Southwestern corn borer

Risk increases with late planting
CEW vs FAW

Fall armyworm

Corn earworm

Photos courtesy Dr. Pat Porter, TAMU
Caterpillar management and Bt

• All transgenic insect control traits are protein toxins from a naturally occurring soil bacterium, *Bacillus thuringiensis*

• Several different Bt toxins have been isolated and are active against different pests

• Two categories:
  • Above ground control (corn borers)
  • Below ground control (corn rootworm)

There is variation in the susceptibility to Bt toxins!
The Handy Bt Trait Table provides a helpful list of trait names (below) and details of trait packages (over) to make it easier to understand company seed guides, sales materials, and bag tags.

At the end of 2018, European corn borer (ECB) damage to Cry1F Bt corn was reported in Nova Scotia, Canada. ECB populations were collected and bio-assayed. The results, published in fall 2019, confirm the first case of practical, field-evolved resistance by corn borer to any Bt trait. In their paper, entomologists from the University of Guelph highlight "preventable causal factors" contributing to ECB resistance in Nova Scotia. A key factor was the continued planting of single-trait Cry1F hybrids. To slow the development of resistance. This transition apparently did not happen in some places.

Unfortunately, single-trait hybrids are just part of the story. As insects become resistant to individual Cry proteins, pyramided hybrids effectively become single-trait hybrids. For example, because ECB is resistant to Cry1F in Nova Scotia, Cry1Ab + Cry1F hybrids are functionally single-trait for Cry1Ab in that province. Entomologists recommend that such pyramids not be used in that region to reduce the chance of ECB resistance to Cry1Ab. Similarly, because western bean cutworm developed resistance to Cry1F, Vip 3A is the only effective toxin to control it. All Vip hybrids, regardless of the number of other Bt in plant, are single-trait for this key pest. Finally, in the southern US, corn earworm (aka cotton bollworm) is overcoming multiple Bt toxins and Vip3A increasingly functions alone in pyramided corn and cotton. Although you can't control how traits are packaged or marketed, it is important to realize which hybrids you plant are not really pyramids, to scout fields for unusual pest pressure, and to report problems promptly so that resistance can be dealt with quickly, as in Nova Scotia.

### Field corn ‘events’ (transformations of one or more genes) and their Trade Names

<table>
<thead>
<tr>
<th>Trade name for trait</th>
<th>Event</th>
<th>Protein(s) expressed</th>
<th>Primary Insect Targets + Herbicide tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agrisure CB/LL</td>
<td>BT11</td>
<td>Cry1Ab + PAT</td>
<td>corn borer + glufosinate</td>
</tr>
<tr>
<td>Agrisure Duracade</td>
<td>5307</td>
<td>eCry3.1Ab</td>
<td>rootworm</td>
</tr>
<tr>
<td>Agrisure GT</td>
<td>GA21</td>
<td>EPSPS</td>
<td>glyphosate</td>
</tr>
<tr>
<td>Agrisure RW</td>
<td>MIR604</td>
<td>mCry3A</td>
<td>rootworm</td>
</tr>
<tr>
<td>Agrisure Viptera</td>
<td>MIR162</td>
<td>Vip3Aa20</td>
<td>broad caterpillar control, except for corn borer</td>
</tr>
<tr>
<td>Enlist</td>
<td>DAS40278</td>
<td>add-1</td>
<td>2,4-D &amp; “FOPs”</td>
</tr>
<tr>
<td>Herculex I (HxI) or CB</td>
<td>TC1507</td>
<td>Cry1Fa2 + PAT</td>
<td>corn borer + glufosinate</td>
</tr>
</tbody>
</table>
The Handy Bt Trait Table for U.S. Corn Production, updated February 2020

<table>
<thead>
<tr>
<th>Trait packages in alphabetical order (acronym that may be used)</th>
<th>Bt protein(s) in the trait package</th>
<th>Marketed for control of:</th>
<th>Resistance confirmed to the combination of Bts in package (check local situation)</th>
<th>Herbicide trait</th>
<th>Non-Bt Refuge % (cornbelt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AcreMax (AM)</td>
<td>Cry1Ab, Cry1F</td>
<td>B C E F G H I J K L M N O P Q R S T U V W X Y Z</td>
<td>CEW FAW WBC</td>
<td>x x</td>
<td>5% in bag</td>
</tr>
<tr>
<td>AcreMax CRW (AMRW)</td>
<td>Cry3A, 35Ab1</td>
<td>B C E F G H I J K L M N O P Q R S T U V W X Y Z</td>
<td>NCR WCR</td>
<td>x x</td>
<td>10% in bag</td>
</tr>
<tr>
<td>AcreMax1 (AM1)</td>
<td>Cry1F, Cry34/35Ab1</td>
<td>B C E F G H I J K L M N O P Q R S T U V W X Y Z</td>
<td>ECB FAW SWB WBC NCR WCR</td>
<td>x x</td>
<td>10% in bag, 20% ECB</td>
</tr>
<tr>
<td>AcreMax TRIsect (AMT)</td>
<td>Cry1Ab, Cry1F, mCry3A</td>
<td>B C E F G H I J K L M N O P Q R S T U V W X Y Z</td>
<td>CEW FAW WBC, WCR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AcreMax Xtra (AMX)</td>
<td>Cry1Ab, Cry1F, Cry34/35Ab1</td>
<td>B C E F G H I J K L M N O P Q R S T U V W X Y Z</td>
<td>CEW FAW WBC, WCR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AcreMax Xtreme (AMX)</td>
<td>Cry1Ab, Cry1F, mCry3A, Cry34/35Ab1</td>
<td>B C E F G H I J K L M N O P Q R S T U V W X Y Z</td>
<td>CEW FAW WBC, WCR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agrisure 3010 (BR)</td>
<td>Cry1Ab</td>
<td>B C E F G H I J K L M N O P Q R S T U V W X Y Z</td>
<td>CEW</td>
<td></td>
<td>20%</td>
</tr>
<tr>
<td>Agrisure 3000GT &amp; 3011A</td>
<td>Cry1Ab, mCry3A</td>
<td>B C E F G H I J K L M N O P Q R S T U V W X Y Z</td>
<td>CEW WCR</td>
<td></td>
<td>20%</td>
</tr>
<tr>
<td>Agrisure Vipera 3110 (VR)</td>
<td>Cry1Ab, Vip3A</td>
<td>B C E F G H I J K L M N O P Q R S T U V W X Y Z</td>
<td>CEW WCR</td>
<td></td>
<td>20%</td>
</tr>
<tr>
<td>Agrisure Vipera 3111 (AA)</td>
<td>Cry1Ab, Vip3A, mCry3A</td>
<td>B C E F G H I J K L M N O P Q R S T U V W X Y Z</td>
<td>WCR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agrisure 3120 E-Z Refuge (BZ)</td>
<td>Cry1Ab, Cry1F</td>
<td>B C E F G H I J K L M N O P Q R S T U V W X Y Z</td>
<td>CEW FAW WBC</td>
<td></td>
<td>5% in bag</td>
</tr>
<tr>
<td>Agrisure 3122 E-Z Refuge</td>
<td>Cry1Ab, Cry1F, mCry3A, Cry34/35Ab1</td>
<td>B C E F G H I J K L M N O P Q R S T U V W X Y Z</td>
<td>CEW FAW WBC, WCR</td>
<td></td>
<td>5% in bag</td>
</tr>
<tr>
<td>Agrisure Vipera 3220 E-Z (V2)</td>
<td>Cry1Ab, Cry1F, Vip3A</td>
<td>B C E F G H I J K L M N O P Q R S T U V W X Y Z</td>
<td></td>
<td></td>
<td>5% in bag</td>
</tr>
<tr>
<td>Agrisure Vipera 3330 E-Z (V3)</td>
<td>Cry1Ab, Vip3A, Cry1A 1.05/Cry2Ab2</td>
<td>B C E F G H I J K L M N O P Q R S T U V W X Y Z</td>
<td></td>
<td></td>
<td>5% in bag</td>
</tr>
<tr>
<td>Agrisure Duracade 5122 E-Z (D1)</td>
<td>Cry1Ab, Cry1F, mCry3A, eCry3.1Ab</td>
<td>B C E F G H I J K L M N O P Q R S T U V W X Y Z</td>
<td>CEW FAW WBC</td>
<td></td>
<td>5% in bag</td>
</tr>
<tr>
<td>Agrisure Duracade 5222 E-Z (D2)</td>
<td>Cry1Ab, Cry1F, Vip3A, mCry3A, eCry3.1Ab</td>
<td>B C E F G H I J K L M N O P Q R S T U V W X Y Z</td>
<td></td>
<td></td>
<td>5% in bag</td>
</tr>
<tr>
<td>Herculex I (HXI)</td>
<td>Cry1F</td>
<td>B C E F G H I J K L M N O P Q R S T U V W X Y Z</td>
<td>ECB FAW SWB WBC</td>
<td></td>
<td>20%</td>
</tr>
<tr>
<td>Herculex RW (HXRW)</td>
<td>Cry3A 35Ab1</td>
<td>B C E F G H I J K L M N O P Q R S T U V W X Y Z</td>
<td></td>
<td></td>
<td>20%</td>
</tr>
<tr>
<td>Herculex XTRA (HXX)</td>
<td>Cry1F, Cry3A, 35Ab1</td>
<td>B C E F G H I J K L M N O P Q R S T U V W X Y Z</td>
<td></td>
<td></td>
<td>20%</td>
</tr>
</tbody>
</table>
Bt terminology

• **Event** – the successful insertion of genes into a crop plant

• **Stacked traits** – toxins that are active against different pest groups combined into one hybrid

• **Pyramid traits** – toxins that are active against the same pest group are combined into one hybrid

• **Resistance** – a genetic shift in a population of insects that makes it less susceptible to a toxin

• **Refuge strategy** – some acreage (the refuge) is planted to non-Bt corn. Insects coming out of these crops are susceptible to Bt, mate with insects that came from Bt → keep overall population susceptible
Insect resistance management, IRM

• Following an IRM plan is the best way to ensure Bt traits last
• Seed companies present IRM plans to the Environmental Protection Agency (EPA) as they register Bt traits
• Non-Bt refuge
  • 1 gene = 50%
  • 2 gene = 20%
  • Can be planted within, adjacent, or separate (within ½ mile)
• Compliance
  • Seed companies are responsible for reporting compliance to EPA each year
  • This is crucial for extending the life of current traits
EPA looking to make changes

- New regulations to extend the life of current Bt traits in corn and cotton
- Will change some IRM strategies and also add additional ones

Why do we need to make changes?
- Current IRM is from 20+ years ago
- Documented resistance
- Vip3A only Bt toxin with no resistance to corn earworm
- Threat of additional resistance
Proposed changes

• Addresses risk factors
  • Single-trait Bt corn
  • Only a few highly effective Bt traits
  • Lack of refuge compliance

• Changes to definition of resistance
  • Field failures are now considered a case of practical resistance
  • These fields will immediately begin a resistance mitigation program
  • Unexpected injury (UXI) will be communicated widely

Some of these changes will substantially impact corn and cotton production in the south.
What does this actually mean?

• Refuge in a bag can be planted in southern states but with a 20% block refuge

• **Phase out all single toxin Bt corn hybrids within 3 years and all pyramid hybrids without Vip3A in 5 years**

What is left?

• Corn: pyramid hybrid with Vip3A or non-Bt variety
What does this actually mean?

- AcreMax Leptra
- Agrisure Viptera 3110
- Agrisure Viptera 3111
- Agrisure Viptera 3220 E-Z
- Agrisure Viptera 3330 E-Z
- Agrisure Duracade 5222 E-Z
- Leptra
- Trecepta
EPA wants to hear from you!

• Seeking feedback on the proposal before it is finalized
• 60-day public comment period is currently open through Nov 6
• Specifically
  • Phase down of traits
  • Refuge compliance monitoring

Summary

• Reduce risk at every step
• Help to preserve the current Bt technologies as long as possible
• Share comments with the EPA!

Questions?

Katelyn Kesheimer
Email: kesheimer@auburn.edu
Office: 334-844-5072
Twitter: @kesheimerIPM